Distinguishing hop varieties hops – is this still relevant?

VARIETY DIFFERENTIATION | The classification of hop varieties into aroma and bitter hops dates back to 1971, a time when there were only four aroma and two bitter varieties in Germany. The two groups could be easily distinguished from each other based on analytical characteristics. Today, differentiation is difficult due to the breeding of numerous new varieties. In particular, the hop varieties used for dry hopping, often referred to as flavor hops, do not fit into the usual scheme, although they are literally "aromatizing hops."

TO CHANGE THIS unsatisfactory situation, it is proposed to divide the group of aroma hops into three groups, namely fine aroma hops, aroma hops and flavor hops. No subdivision is required for bitter hops.

The European Union "Protocol for Distinctness, Uniformity and Stability Tests" from 15 November 2006 deals exclusively with the description of hop plants and their cultivation properties. Annex II classifies hop varieties based on the "type of use" criterion: "aroma," "bitter," "high alpha," "ornamental" and "other."

However, this is the full extent of the information. In particular, there are no points of orientation for brewers.

Therefore, the question to be addressed is posed from the viewpoint of brewers who require guidance on how to differentiate the numerous hop varieties based upon these pre-determined groups. These considerations are focused on the cultivation of hops in Germany and are only intended as a means for initiating a discussion on the topic.

The origins of placing hop varieties into groups

First of all, no hops in existence contain only aroma substances or only bitter substances. This, in and of itself, reveals straightaway the difficulty in assigning hops to groups designated as "aroma hops" or "bitter hops."

The categorization of hops into aroma and bitter varieties was carried out by the EEC in 1971. Aroma hops produced lower yields of bitter substances but enhanced the quality of beer, such as imparting a more harmonious bitterness and a finer hop aroma as well as increasing the drinkability, especially when added late in the brewing process. Bitter hops are added at the beginning of the boil and only convey bitterness to the beer. As the use of bitter hops became more widespread, some breweries started to advertise that they were using aroma hops, emphasizing their higher reputation. Over time, the continuous development of analytical criteria has provided tools for the differentiation of hop varieties, which may also be employed to define the limits for each group of hops.

Data for the hop varieties grown in Germany in the 1970s are depicted in table 1. These include the four landraces of aroma hops (Hallertauer Mfr., Hersbrucker, Spalter, Tettnanger) as well as two bitter varieties, Northern Brewer and Brewers Gold. The key metrics developed over time serve as the basis for this analysis [1, 2].

Aroma hops were expected to be elegant and fine in smell, while bitter hops were

RANGES OF ANALYTICAL KEY METRICS IN AROMA AND BITTER HOPS GROWN IN GERMANY AROUND 1970

		Aroma	Bitter
α-acids	% w/w	3.1–4.1	7.0–9.2
β:α		1.3–1.4	0.6
Cohumulone ratio	% rel.	20–25	27–44
Polyphenols	% w/w	4.4–5.3	3.7–3.9
Total oil	ml/100 g	0.6–0.75	1.3–1.5
Linalool	mg/100 g	4–6	4–7

Table 1

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as either aroma or bitter

characterized as strong and aggressive, often exhibiting fruity notes, i.e., they are more "unconventional." Therefore, based on these descriptors, aroma and bitter hops were analytically and sensorially easy to distinguish, and their differences were clearly delineated. There were no commonalities except for linalool.

What changed since the last decades?

Two fundamental shifts have emerged since 2000:

The first was a change in the accepted scientific opinions on some topics. Still accepted is a positive effect of low cohumulone ratio and a high beta : alpha ratio. But the importance of mono- and sesquiterpenes is neglectable, because they are evaporated in the brew kettle. Older doctrines no longer apply, e.g., myrcene is now no longer considered "evil" and likewise farnesene simply "good." Esp. the thiols are today essential in flavor hops for dry hopping, while they had a bad reputation in the past.

The second shift was that varietal breeding has increased enormously and continues to do so, e.g., from the development of five new varieties from 2001 to 2005 to 22 new varieties in the years 2016 to 2020 in Europe. The primary driving forces behind these accelerated breeding efforts comprise the search for climate and disease tolerances as well as the desire of craft brewers of new aromas for their beers. New hop varieties are now protected, making it potentially lucrative to license their cultivation. In addition to state institutions, there are private breeders.

The importance of "flavor" hops

Flavor hops, as they are known, perform additional tasks when they are used for dry hopping compared to conventional hop additions on the hot side. They are intended to impart an aroma, mostly fruity notes, as directly as possible to beer. Flavor hops serve as an agent or transmitter for aromas actually atypical for hops. They are literally "aromatizing hops." The composition of the bitter substances and the polyphenols plays a minor role in dry hopping.

Flavor hops are presently classified in the aroma group. However, this has necessitated significantly expanding the ranges for the key metrics for analyzing hop attributes.

RANGES OF ANALYTICAL KEY METRICS FOR AROMA AND BITTER HOPS GROWN IN GERMANY IN 2022

		Aroma	Bitter
α-acids	% w/w	3.1–12.0	11.3–18.6
β:α		0.6–2.4	0.3–0.5
Cohumulone ratio	% rel.	15–30	20–36
Polyphenols	% w/w	3.7–5.4	2.8–4.0
Total oil	ml/100 g	0.55–2.5	1.7–3.2
Linalool	mg/100 g	3–18	8–19

Table 2

RANGE OF ANALYTICAL CHARACTERISTICS OF THREE AROMA HOP GROUPS AND BITTER HOPS

		Fine Aroma	Aroma	Flavor	Bitter
α-acids	% w/w	< 7	6–10	< 12	> 12
β:α		0.8–2.5	< 0.7	< 0.5	nr*
Cohumulone ratio	% rel.	< 28	< 32	< 35	nr*
Polyphenols	% w/w	> 4.0	> 3.5	> 3.0	nr*
Hop oil	ml/100 g	< 1.2	> 0.6–1.5	> 1.0	> 1.5
Linalool	mg/100 g	> 3–8	> 4–12	> 6	nr*

Table 3 **no relevance*

The current situation

Table 2 shows the actual range of analytical datas of aroma and bitter hops.

The numerous new aroma varieties have enormously increased the analytical range for characterizing these hops. A clearly-defined analytical delineation of aroma and bitter hops is problematic since the boundaries between the two are eroding.

The evaluation made by the breeder is decisive in determining to which group a new variety is assigned. Since aroma hops are associated with having a higher value, the breeder tends to designate a newly developed variety as an aroma hop. Objective criteria are often not required. Northern Brewer (2016) and Brewers Gold (2021) are two examples of the seemingly arbitrary "promotion" of two bitter varieties to the aroma group. There exist no scientific publications in brewing which provide justification for this classification. If a hop was originally bred as a bitter variety – yet does not meet the expectations for alpha acid content (>15%) and alpha yield (> 500 kg/ha) – it is registered as an aroma variety.

This indicates that the current method of grouping hop varieties is therefore unsatisfactory. It suffers also from a lack of transparency and reproducibility.

What alternatives are there?

- The current unsatisfactory and non-transparent procedure will continue.
- Hop varieties will cease to be separated into groups.
- Aroma hops, which cover a particularly wide spectrum, can be further divided into subgroups.

A proposal below using German varieties as an example:

Fine aroma varieties as a group would encompass all the landraces, such as HAL, HEB, SAZ, SPA, TET, as well as closely related varieties, such as Saphir and Spalter Select. These varieties are used for brewing superbly well-balanced bottom-fermented styles like lagers and pilsners.

Aroma varieties, such as Perle, Hall. Tradition, Opal, Smaragd, Diamant, Aurum, Ariana and Callista can be added at any point from the beginning and the end of the boil. They can at least partially replace noble aroma varieties in many beers.

Flavor varieties possessing a pronounced fruity character are often used for dry hopping.

Bitter varieties as a group are primarily added at the beginning of the boil. Attributes such as aroma compounds or polyphenols play a subordinate role.

The current analysis data for these four proposed groups are shown in table 3.

A concerted effort should be made to expand the criteria for aroma hops, e.g., to include attributes, such as the oxygenated fractions or the esters. At the moment, analysis of the thiols is neither sufficiently reproducible nor comparable between laboratories. Data on this is urgently needed.

Summary

The distinction between aroma and bitter hops was understandable considering the limited number of varieties available up into the 1970s. In addition to obvious analytical differences, their purpose was also defined based upon when they were added in the brewing process. Aroma hops were primarily added at the end of the boil, while bitter varieties were added solely at the beginning.

The multitude of varieties developed since then has resulted in an enormous expansion of the analytical data characterizing the attributes of hops. Breeders, in large part, determine into which group a new variety will be classified; however, they lack sufficient experience regarding, e.g., the suitability of a particular variety for certain applications.

The increasingly popular introduction of hop aroma into beer by means of dry hopping is a technique that supersedes the rules which were previously followed in the brewing industry. Hops have become the transport mechanism for "unconventional," even unhoppy, fruity flavors.

Continuing to observe the current method of classifying hop varieties into one of the two aforementioned groups does not represent a viable option. Two alternatives remain:

- abolish the designation by group (either as "bitter" or "aroma");
- adopt a proposal to divide the aroma hop varieties into three groups: fine aroma varieties, aroma varieties and flavor varieties. Bitter varieties would belong to the same group as before. Varietal determination and classification should be overseen by relevant committees. ■

References

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